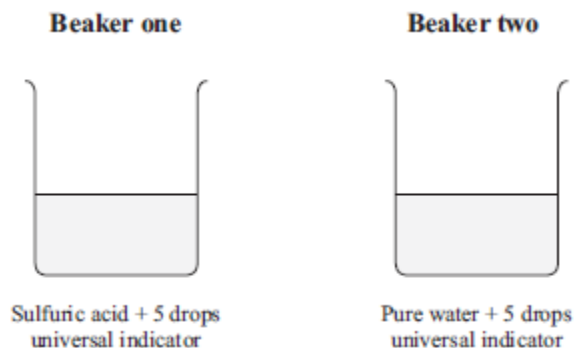


Acids and Bases

1) Two beakers are shown below. Beaker one contains sulfuric acid solution and 5 drops of universal indicator. Beaker two contains pure water and 5 drops of universal indicator. Sodium hydroxide solution was added to both beakers until no more changes were observed.



- a) Write a word equation AND a balanced symbol equation for the reaction between sulfuric acid and sodium hydroxide.
- b) What is the colour of universal indicator in each solution at the **start**?
- c) Describe the colour changes as sodium hydroxide solution is added to each beaker, AND explain what this tells you about the changing pH of each solution.
- d) Explain the relationship between the pH of the solutions and the **ions** in the solutions, as the sodium hydroxide is added to each of the beakers.

2) A student wanted to make the neutral salt, sodium nitrate.

- a) Explain how to make sodium nitrate by mixing sodium carbonate and nitric acid solutions using school laboratory equipment (your explanation may use notes and diagrams).

b) Explain how litmus paper could be used during the process described to show the salt being produced is **neutral**.

c) Write a word equation AND a balanced symbol equation for the reaction between sodium carbonate and nitric acid.

3) A student put 10 ml of dilute nitric acid in a boiling tube with five drops of universal indicator. Sodium hydroxide of the same concentration was then added. The following observations were recorded.

Amount of sodium hydroxide added (ml)	Colour of solution
0	red
10	green
20	purple

Discuss the reaction occurring as sodium hydroxide is added to the nitric acid. In your answer you should:

- explain the relationship between the colours observed and the pH of the solution
- explain which ions cause the different colours of the solution
- write a word equation for the reaction AND a balanced symbol equation for the reaction.

4) A student wanted to make the salt, magnesium chloride. Discuss how the student would make magnesium chloride salt from hydrochloric acid and magnesium oxide. In your answer you should:

- state what type of reaction occurs
- write a word equation AND a balanced symbol equation for the reaction between hydrochloric acid and magnesium oxide
- explain how you would make magnesium chloride in a school lab from hydrochloric acid and solid magnesium oxide (include labelled diagrams).

5) A student puts 5 mL of dilute hydrochloric acid into a boiling tube and adds five drops of universal indicator to the solution. The student then takes a solution of sodium hydroxide of the same concentration as the acid and adds it one drop at a time to the acid until the colour stops changing.

a) i) Describe the colour of the universal indicator solution:

- in the hydrochloric acid before any sodium hydroxide was added.
- when the sodium hydroxide was added and the colour of the solution **stopped changing**.

ii) As the sodium hydroxide is added several colour changes occur. Explain how the colour changes relate to pH AND what ions are present in the solution colour changes.

b) The student combines **equal** volumes of nitric acid solution and sodium carbonate solution. Both solutions have the **same concentration**. Discuss what happens in this reaction. In your answer, you should:

- name the type of reaction involved and the ions involved
- describe what the student would observe
- state the products of the reaction and link these to the observations made
- write a word equation for the reaction
- write a balanced symbol equation for the reaction.

6) A student reacted dilute sulfuric acid solution with solid sodium hydrogen carbonate. Discuss the reasons for any observations the student would make for this reaction. In your answer you should:

- Describe any observations the student would make for this reaction.
- Write a word equation and balanced symbol equation for the reaction of sulfuric acid with sodium hydrogen carbonate.
- Explain how the observations link to the products formed.

7) A student carried out an experiment to **neutralise** sulfuric acid by adding sodium hydroxide to it. Discuss **how** the student could have determined when the sulfuric acid had been neutralised **and** what effect adding the sodium hydroxide has on the pH of the solution. In your answer include:

- an explanation of neutralisation in terms of an acid-base reaction
- the name of the indicator used
- observations that the student would make as the sodium hydroxide is added to the acid
- a word and balanced chemical equation for the reaction.

8) A student reacted zinc oxide with sulfuric acid, and wrote the following **incorrect** equation to represent the reaction:



The equation contains THREE errors.

a) Rewrite the equation so that it is a **correctly** balanced chemical equation.

b) Discuss the reasons for the three changes made to correctly balance the chemical equation.

9) An important part of keeping swimming pools safe is to keep the pH of the water balanced in the range 7.0 to 7.6. Three chemicals used in pools are chlorine compounds (that react with water to produce hydrochloric acid), sodium hydrogen carbonate and aluminium sulfate.

a) Complete the following table to show the characteristics of the solutions listed in the table below.

Solution	Estimated pH	Colour when tested with Universal indicator
Hydrochloric acid	1	(i)
Sodium hydrogen carbonate	(ii)	blue
Aluminium sulfate	5	(iii)
Water	(iv)	green

b) The pool was tested and found to have a pH of 6.5. Sodium hydrogen carbonate was used to raise the pH of the water. Discuss how sodium hydrogen carbonate raised the pH of the water, and include in your answer a word equation **and** a symbol equation for the reaction of sodium hydrogen carbonate with hydrochloric acid.

10) a) State the colour seen if red litmus and blue litmus are added to separate samples of the following solutions.

Solution	Red litmus added	Blue litmus added
Water		
Sodium		
Hydrochloric		

b) Write down the pH number that best represents the pH of each of the following: pure water, sodium hydroxide, hydrochloric acid

11) a) Copper sulfate is a salt. Copper sulfate crystals can be prepared in the laboratory by adding copper oxide to an acid. Name the acid that would be used to make copper sulfate crystals and explain your choice

b) Write a word equation for the reaction of copper oxide and the acid.

c) Hydrochloric acid is added to a sodium carbonate solution. Describe the observation(s) that would be made when this reaction occurs, and explain the reason for them.

d) Write a balanced chemical equation for the reaction between hydrochloric acid and sodium carbonate solution.

12) a) The pH values of three substances are given below:

Hydrochloric acid pH = 1

Potassium carbonate solution pH = 9

Sodium hydroxide solution pH = 14

When Universal Indicator solution is added to each of the substances listed above, what colour would result?

b) Potassium carbonate solution is added slowly to the hydrochloric acid (without indicator) in a beaker until no further change is seen.

i) Describe what you would see happening when potassium carbonate is added to the acid.

ii) Write a balanced chemical equation for the reaction between potassium carbonate and hydrochloric acid.

c) In another experiment, sodium hydroxide solution is added **slowly** to the hydrochloric acid to which **Universal Indicator solution** has been added.

Describe how the colour of the Universal Indicator solution changes as the sodium hydroxide solution is added. Discuss how the **colour** changes relate to the substances present in the solution. Use the substances from the key list: water, sodium chloride, sodium hydroxide, hydrochloric acid

13) Epsom salt has the chemical formula MgSO_4 . It can be prepared by reacting an acid with magnesium hydroxide.

a)i) Give the chemical name for MgSO_4

ii) Name the acid used in this reaction

b) Write the word equation for the preparation of MgSO_4 .

c) This reaction is described as a **neutralisation** reaction. Explain what is meant by the term **neutralisation**.

14) a) James carried out an investigation to see how many colours he could make with universal indicator. He started with 5 mL of dilute hydrochloric acid in a boiling tube and added 5 drops of universal indicator. The solution turned red. James then added dilute sodium hydroxide to the boiling tube, a drop at a time, until the solution turned purple.

i) James obtained three more colours as he added the sodium hydroxide to the acid. These colours were green, blue and yellow. Write the colours in the correct order as they appeared.

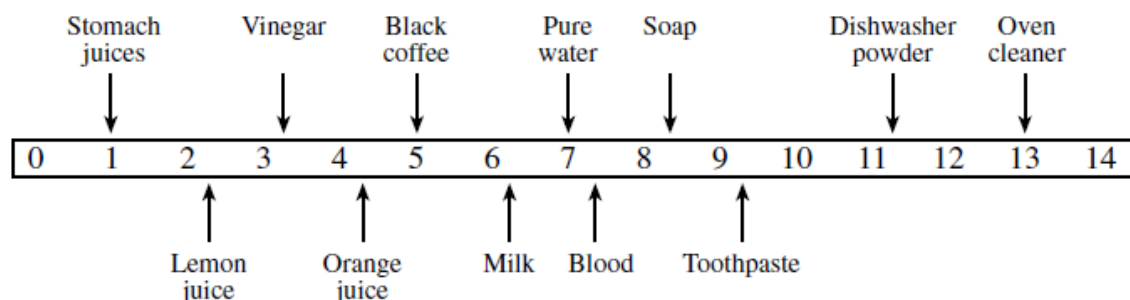
ii) Which colour on the chart corresponds to a pH of 1–2?

iii) Discuss what effect adding the sodium hydroxide has on the pH of the solution in the boiling tube.

15) i) A student has one test tube containing magnesium oxide and another containing magnesium carbonate. Both substances are white powders. The student has to identify which test tube contains magnesium oxide and which test tube contains magnesium carbonate, using only sulfuric acid. Explain how the student would do this.

ii) Magnesium hydroxide also reacts with sulfuric acid. Write a **balanced symbol** equation for this reaction.

16) a) write down the colour of the following substance with i) Universal Indicator and ii) litmus paper Hydrochloric acid Calcium oxide



b) i) Name the most strongly alkaline substance shown above.

ii) Which fruit juice is more acidic than vinegar?

iii) Bacteria can turn sugar in your mouth to acid that attacks teeth. Explain why toothpaste has such a high pH

17) Hydrochloric and sulfuric acids both react with carbonates and hydrogen carbonates to produce a gas.

i) Name the gas.

ii) Write the **word equation** for the reaction of hydrochloric acid with copper carbonate.

iii) Write a fully balanced **symbol equation** for the reaction of sulfuric acid with sodium hydrogen carbonate.

iv) Explain why the reactions of acids with carbonates and hydrogen carbonates are called neutralisation reactions.